REMARKS

In paragraph 1 of the Office Action Applicant's prior election of method claims 13-26 is acknowledged. Applicant confirms the prior election of claims 13-26 and cancellation of claims 1-12 without prejudice.

In paragraph 2 of the Office Action claims 13-26 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, stating:

> "In claim 13, "an initial thickness DLC layer portion" in line 4 has no clear relationship to "a diamond-like carbon (DLC) layer" of line 3, but both limitations introduced as different things are fabricated upon the magnetic layer without any clear differentiation or relation of where there upon they are.
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> Also, use of relative terms that lack clear metes and bounds in the claim, in a definition in the specification or in cited relevant prior art, are vague and indefinite. See "hard" in all the preambles, and see 'low" in line 5 and "high" in line 7 of claim 13, which modify "carbon ion beam energy". Also, see "mid-range" in claim 16. Note page 1 of the specification gives a value in parenthesis (for generally low energy, but as this does not agree with the ranges supplied by dependent claim 14, and does not provide a definition to clarify this issue. (if it was the same, and considered a definition, then claim 14 would not further limit.) Further note in claim 22, "low.., beam energy" is defined with "higher..." being described with respect to the low energy.
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> In claim 17 "said intermediate carbon ion beam energy" lacks antecedent basis due to use of inconsistent terminology with claim 16, which uses "a relatively mid-range carbon ion beam energy".
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> In claim 22, the clarity or format of the claim could be improved by standardizing use of articles to be consistent with showing proper antecedent basis. Specifically, as "the.., energy level" and "the thickness" are newly introduced in line 8, deletion of the article "the" would be appropriate, while in line 9, insertion of --the-- or --said-- before "carbon ion species" would be consistent with the limitations' prior introduction in line 5.
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> It is also noted, that while "smoothly" is a relative term, its use in "varied smoothly with time" may be considered to describe how the energy level varies smoothly, especially considered in context and in juxtaposition to claim 24, where it varies as a step function with time, i.e. incrementally.
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> In claim 20-21 and 25-26, when are the N ions intended to be implanted? Is this a process totally separate from the fabrication of the DLC layers or sublayers, or occurs as part of the fabricating steps or what?"

Responsive thereto, Applicant has amended the claims to cure the grounds for indefiniteness. Specifically, regarding the first paragraph in this ground of rejection Applicant has amended

claims 13, 16, 18, 20, 22 and 25 to clarify that the phrase "an initial thickness DLC layer portion" refers basically to a portion of the DLC layer. Regarding the second paragraph of this rejection, Applicant has amended claims 13 and 22 to provide clarity to terms such as "low" "mid-range" and "high". However, with regard to the word "hard" in the preamble, Applicant traverses this ground of rejection. Specifically, the phrases "hard disk drive" and "hard disk" are well known in the industry, and thus the word "hard" is not used in a relative sense, but rather in a definitional sense. Responsive to the third and fourth paragraphs of this rejection Applicant has amended the claims to provide clearer antecedent basis. Regarding the fifth paragraph of this rejection the phrase "varied smoothly with time" is meant to describe how the energy level varies with time (that is, smoothly), where in claim 24 the energy level varies as a step function with time (that is, incrementally). Regarding the sixth (last) paragraph of this rejection, claims 20-21 and 25-26 have been amended to clearly state that the N ions are implanted as part of the fabricating steps. Applicant therefore respectfully submits that the claims have been amended to cure the grounds of indefiniteness cited in this second paragraph of the Office Action.

In paragraphs 3 and 4 of the Office Action claims 13-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Falabella (5,763,087), in view of Ueda et al (5,776,602), optionally in view of Schmidt et al., stating:

> "Falbella teaches deposition of "amorphous diamond" (a-C is an allotrope of carbon generally considered a form of DLC or diamond like carbon), via carbon ion beams, via a technique that reduces the intrinsic stress of the coating, and are indicated to be useful on magnetic media. Falabella disclose that density, hardness and intrinsic stress levels of a-C depend on ratios of sp^2 to sp^3 bonds, which can be controlled by the incident C ion energy, substrate surface temperature and impurity concentration. Increasing the incident C ion energy is noted to ultimately reduce stress. Nitrogen is also suggested as a dopant for reducing stress. See the abstract; Fig. 1; col. 2, line 15-31, 40-45 and 62 - col. 3, line 61, esp. 23-45; and col. 4, lines 13-35, noting use of carbon ion beams with 20eV-200 eV energies and that instead on an intermediate layer of metal, carbon may be deposited to form a diffuse interface. On col. 5, lines 1-19 (Ex. 3), 22 eV C ions are of sufficient energy to cause embedding to several mono-layers, and lines 56 - col. 6, lines 16, show increasing mean C ion energy causes reduction of intrinsic stress, comparing N doped and non-doped deposits to show further stress reduction. While Falabella does not explicitly teach the specific sequence of energy use claimed, (10-20ev, then 100eV, high and low etc.), he does specifically suggest "deposition conditions may be varied to provide a range of hardness and stress levels. Moreover, the material for the substrate and

> intermediate layer may be modified in order to provide better adaptability to various types of applications".
>
> Ueda et at (602) provides teachings specifically directed to magnetic recording media carbon protective coatings, and while the examples therein use sputtering techniques, col. 8, lines 10-13 specifically teaches the equivalence of ion beam deposition and sputtering for the processes Ueda et at (602). Particularly note on col. 4, lines 9-24 and 40-68 the teachings of atomic ratio of N to C of 5-20% and the deposit of plural carbon layers with a gradiant of nitrogen dopant, with a maximum concentration on the upper surface where lubricant is to be deposited. Col. 5, lines 19-25 discuss hardness and density, line 50-52 move [N] with col. 6, lines 1-49 discussing the importance of the graded amount of N, the sp^2 and sp^3 hard structure of the coatings, intrinsic stress, etc., at the interface with the lubricant layer. While Ueda et al has the multilayer teachings and equivalence of ion beam and sputtering to form deposits, they do not have energy variation teaching to produce difference in layer properties, nor specific examples of ion beam usage.
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> Given the above teachings of Falabella and Ueda et al (602), it would have been obvious to one of ordinary skill in the art, that as Ueda et at shows the desirability of high [N] and reduced stress at the carbon protective layer/lubricant interface, and that Falabella teaches that with ion deposition both N and energy of deposit effect the stress and sp^2 to sp^3 ratios, that with graded energy usage and [N] would have been expected to have been effective in produces the desired structure for magnetic media as taught by Ueda et al, especially considering Falabella's suggestion of varying their parameters during deposit to effect stress levels, and Ueda et al equivalence teachings for ion beam and sputtering.
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> Optionally, Schmidt et al (abstract;; Fig. 1, 3; col. 6; col. 9, lines 8-50 and table 1 on col. 7-8) is cumulative too the above teachings, where "primary" ion beam deposition may be used, providing suggestions of multiple layers, abrupt or graded, where initial deposit is for adhesion and softer (thus may use lower energy beam), followed by harder layer(s) on which lubricant is deposited. Therefore, it would have been further obvious to employ the technique of Falabella using initially lower energies for the ion beam deposition to provide for improved adhesion with the substrate as suggested by Schmidt et at, especially as this is consistent with Falabella's teaching of taking steps for adhesion purposes (intermediate or different layer)."

Responsive hereto, Applicant has amended the claims to more clearly recite Applicant's invention, and Applicant has added new claims 27-29. Applicant respectfully submits that the claims, as amended, recite limitations that are not obvious from the teachings of the prior art, as is next discussed.

The present invention is concerned with limiting the penetration of carbon ions into the magnetic layer of the hard disk during the fabrication of a DLC coating on the magnetic layer. Significantly, none of the prior art recognizes this problem nor suggests any solution for this

problem. Therefore, while the prior art does describe various methods for fabricating DLC coatings, the prior art does not teach the particular multilayer coating of the present invention nor does it even suggest the significance and efficacy of the particular coating of the present invention to a magnetic layer of a hard disk. Each of the references is next discussed and the non-obviousness of the claim limitations with regard to the teachings thereof is described.

Falabella is primarily concerned with reducing stress levels within amorphous carbon coatings, typically through the use of nitrogen as a dopant. Falabella does not teach that it is detrimental to first expose the magnetic layer of the hard disk to a relatively high energy (such as greater than 50 eV) initially. Fallabella does not teach that a thickness of a low energy (such as 20 eV) DLC layer can be made harder through the subsequent application of carbon ion species having a higher energy. Indeed, while Fallabella does suggest "deposition conditions may be varied to provide a range of hardness and stress levels." it does not indicate what deposition conditions may be varied nor how they may be varied to achieve differing ranges of hardness and stress. Such deposition conditions include concentrations of various gasses which produce the ions, chamber vacuum conditions and substrate temperatures, ion beam energy levels, time duration of deposition processes, thicknesses of initial layers prior to the deposition of subsequent layers and various other parameters which depend on differing systems in which the DLC layer deposition is conducted. Thus, while Falabella suggests the variation of deposition conditions to provide a range of hardness and stress levels, Falabella fails to address the problems which the present invention addresses nor the specific solutions provided in the application and set forth in the claims. One skilled in the art would merely be left to guess amongst the various possible process conditions, based upon Falabella's suggestion, with no guidance provided in Falabella with regard to the problems in Applicant's invention and Applicant's variation of process parameters (specifically ion beam energy) at particular times where a thickness level of a prior layer has been achieved.

Ueda focuses upon DLC coatings having varying properties dependent upon the percentage of nitrogen, or other dopant, that is added to the coating. As pointed out by the Examiner, Ueda does not teach carbon ion deposition energy variation. The combination of Falabella and Ueda simply teaches one skilled in the art that different types of DLC coatings can be created in which various parameters can have various values. There is no motivation provided in the combined teachings of Falabella and Ueda to provide the specific variations in

carbon ion beam energy (first lower energy beam deposition, followed by higher energy beam deposition) to prevent unwanted carbon ion penetration into the magnetic layer of the hard disk.

Schmidt teaches that the properties of a DLC layer will differ depending upon the choice of process parameters. Schmidt, in col. 9, lines 12-50 describes a three layer coating having a relatively soft first layer, a hard middle layer and a lubricated (by addition of dopant) top layer. While this is an example of the generalized statement of Falabella that coatings can be created by varying process parameters, this coating of Schmidt neither teaches nor renders obvious Applicant's particular coating as set forth in the claims. Specifically, Applicant's coating includes an initial thickness portion formed with a relatively low carbon ion beam energy of less than approximately 20 eV and at least one relatively high carbon ion beam energy of greater than approximately 50 eV (as set forth in independent claim 13). Applicant's further claims having more detailed DLC layer properties such as intermediate energy level ion beam portions and thickness ranges of the initial, middle and final deposited layers are neither taught by nor obvious from the combined teachings of the prior art. Basically, while the prior art teaches that DLC coatings having various properties can be created, the specific limitations of the coatings set forth in the claims would only be arrived at through blind trial and error by those skilled in the art. This is because there is no teaching in the prior art with regard to the problem addressed by Applicant's invention nor the steps that are taken (that is, specific parameters varied to create specific layers in a specific sequence) that lead to the solution embodied in Applicant's invention as set forth in the claims.

Applicant therefore respectfully submits that the claims, as amended, recite limitations that are neither taught by nor obvious from the teachings and combined teachings of the prior art. Applicant therefore respectfully submits that the claims, as amended, recite allowed subject matter.

In paragraph 5 of the Office Action other art of interest includes Martin et at with further DLC deposition teachings, with ion beam usage as alternative, and their discussion of DLC in col. 1-2, include the amorphous "diamond" of Falbella. Responsive thereto, Applicant has reviewed the Martin et al prior art and believes that the teachings thereof are cumulative to the teachings of the applied art.

Having responded to all of the paragraphs of the Office Action, and having amended the claims accordingly, Applicant submits that the claims, as amended, are patentable over the cited prior art. Applicant therefore respectfully submits that the application is now in condition for allowance, and Applicant respectfully requests that a Notice of Allowance be forthcoming at the Examiner's earliest opportunity.

Should the Examiner have any questions or comments with regard to this amendment, a telephonic conference at the number set forth below is respectfully requested.

Respectfully submitted,

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I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313.

June 30, 2003
(date)

(Signature of Patricia Beilmann)

ATTACHMENT A - S/N 09/721,264

MARKED UP COPY OF THE AMENDED CLAIMS

13. (Twice amended) A process for fabricating a magnetic media hard disk comprising:

fabricating a magnetic media layer upon a surface material of a substrate;

fabricating a diamond-like carbon (DLC) layer upon said magnetic layer by:

fabricating an initial thickness [DLC layer] portion of said DLC layer upon said magnetic layer utilizing a relatively low ion carbon beam energy of less than approximately 20 eV;

fabricating a subsequent thickness [DLC layer] portion of said DLC layer upon said initial thickness [DLC layer] portion of said DLC layer utilizing [a] at least one relatively high carbon ion beam energy of greater than approximately 50 eV.

16. (Twice amended) A process for fabricating a magnetic media hard disk as described in claim 13, including fabricating an intermediate thickness [DLC layer] portion of said DLC layer between said initial thickness [DLC layer] portion and said subsequent [DLC layer] portion, wherein said intermediate thickness [DLC layer] portion is fabricated utilizing a relatively mid-range carbon ion beam energy between said relatively low carbon ion beam energy and said relatively high carbon ion beam energy.

17. (Once amended) A process for fabricating a magnetic media hard disk as described in claim 16 wherein said [intermediate] mid-range carbon ion beam energy is approximately 50 eV.

18. (Once amended) A process for fabricating a magnetic media hard disk as described in claim 17 wherein said DLC layer has a thickness of approximately 10 Å following the deposition of said initial thickness [DLC layer] portion, and said DLC layer has a thickness of approximately 19 Å following the deposition of said intermediate thickness [DLC layer] portion, and said DLC layer has a final thickness of approximately 25 Å following the deposition of said subsequent thickness [DLC layer] portion.

20. (Once amended) A method for fabricating a magnetic media hard disk as described in claim 13 wherein nitrogen ion species are deposited along with said carbon ion species within said subsequent thickness [DLC layer] portion.

22. (Twice amended) A method for fabricating a magnetic media hard disk comprising:

fabricating a magnetic material layer upon a material surface of a substrate;

fabricating a diamond-like carbon (DLC) layer upon said magnetic layer, wherein said DLC layer is fabricated by:

depositing carbon ion species upon said magnetic layer utilizing a relatively low carbon ion beam energy level of from approximately 10 eV to approximately 20 eV, to deposit an initial thickness portion of said DLC layer [thickness];

subsequently increasing the [carbon ion beam] energy level of said carbon ion beam as the thickness of said DLC layer increases due to the deposition of said carbon ion species within said DLC layer, such that [higher energy] a portion of the carbon ion beam species of said increased energy level carbon ion beam become implanted within said initial thickness portion of said DLC layer [thickness], and such that another portion of said carbon ion beam species of said increased energy level carbon ion beam become deposited on top of said initial thickness portion of said DLC layer.

25. (Once amended) A method for fabricating a magnetic media hard disk as described in claim 23 wherein nitrogen ion species are implanted along with said carbon ion species within said DLC layer thickness.